CRUISE REPORT

C-104

Scientific Activities

Undertaken Aboard

SSV *Corwith Cramer*

Miami - Bahamas - Port Antonio - Roatan - Miami

9 February 1989 - 22 March 1989

Sea Education Association
Woods Hole, Massachusetts

PREFACE

The purpose of this cruise report is to summarize the scientific activities of cruise 104 of the SSV Corwith Cramer. The summary includes abstracts from the projects conducted by the students of class C-104. The projects represent the final fruit of a process which begins in Woods Hole during the shore component when possible topics are researched and then refined into written and oral proposals. At sea, a variety of specimens, observations, and measurements are collected and analyzed by the students for presentation to their shipmates. The written projects are returned to Woods Hole for use in the long-term science objectives of SEA and in helping future students design their work. Much of this work was written at sea and represents a first interpretation of the data.

The hard work and great cooperation of the staff and students made cruise C-104 a success. The skilled guiding hand of Captain Terry Hayward allowed science and seamanship to thrive and overcome challenges from "northers" and coral reefs. I warmly thank him and his nautical staff for their ability and friendship. Pete Kalajian, our first mate, brought an experienced eye and sincere interest in teaching and learning to our voyage. His fluent Spanish also allowed a smoother passage for our visitor. Jim "Homer" Holm brought a West Coast flair to our decks as he fulfilled his second mate's duties. Thanks for driving the inflatable on our Little San Salvador expedition! Jeff Stone was new to SEA and he did a terrific job of teaching and sailing; I hope to sail with you again soon. Jim Taralli did a fabulous job keeping up with demands in the engineering department. His help along with Pete's efforts in keeping the winch and PDR running was essential and his good cheer and moustache appreciated by all. Our artistic steward, Rick Jones supervised a succession of culinary delights and kept spirits high throughout the voyages. I thank you one and all for a memorable time.

The Assistant Scientists kept the laboratory lively around the clock. They kept the samples and data flowing, the records intact and the education ongoing. We were very fortunate to have the skill, experience and personalities of three fine scientists on C-104. Gretchen Rollwagen is the master of her job whether looking after equipment, helping with the computer, or teaching--I was delighted with her efforts. Trina Abbott, our second Assistant brought her botanical knowledge, and ever-striving personality to our lab--it was great sailing with you, Trina! Alum Carolyn Sheild returned to SEA as an Assistant Scientist where she taught and worked with high spirits and the diligence of a good scientist. What a crew! Thanks so much for all your hard work.

Several visitors assisted with our program. Mort Maser learned about our program and helped sail us to Mathewtown. Rob Nawojchik was a boost to the watches in the lab and on deck. Rob was particularly helpful interpreting the life of Little San Salvador. Dian Gifford exposed us to the world of microplankton on the leg from Jamaica to Roatan. Our visitor/observer from the Columbian navy, Orlando, was a rare delight. He overcame the language barrier with persistence and good humor, and worked alongside us to sail and educate. He was a terrific shipmate and a big addition to C-104. Muchos gracias to all our fine visitors!

The real success of C-104 rests squarely on the students who worked through sickness and storm to keep the ship and its science going. Their efforts, patience and good spirits make the legacy of C-104 a high standard for those who follow--and I thank them all for this good trip.

Chuck Lea
Chief Scientist

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INTRODUCTION

A. Research Program

This cruise report provides a record of the scientific activities conducted on C-104. The oceanographic research on the cruise was almost entirely devoted to accomplishing individual projects designed during the six week shore component taught in Woods Hole immediately preceding the cruise. The research projects emphasize the application of theoretical concepts to the study of the oceans.

The cruise track of C-104 (Fig. 1, Appendix A) was designed to allow a variety of marine environments in the Bahamas and the western Caribbean to be studied. At the stop at Little San Salvador, projects were mostly concerned with the large Central Lagoon. Aspects of hydrography and biology were examined as well as the island's sediment distribution and supply. Biological and physical oceanographic distribution patterns were the subject of a variety of studies. By travelling from the Sargasso Sea through the Windward Passage and west to the Yucatan Strait, students were able to compare the influences of a variety of currents, water masses, and the presence of islands, on *Sargassum* zooplankton, fish, as well as the distribution of tar and plastic. At Pedro Bank, south of Jamaica, the influence of water motion on plant life and sediment distribution was examined.

The data were gathered primarily for use in student projects but serve as a reference for future. The station list is given in Appendix B and summaries of individual sampling efforts of different equipment listed in Appendices C to I. A summary of Rob Nawojchik's observations at Little Salvador are included in Appendix J.

TABLE 1

Itinerary

Port	Arrive	Depart
Miami, Florida		9 February 1989
Freeport, Bahamas*	11 February	11 February
Mathewtown, Bahamas*	20 February	20 February
Port Antonio, Jamaica	24 February	26 February
Roatan, Honduras	9 March	12 March
Miami, Florida	22 March	

*Port stop for customs and immigration clearance only.

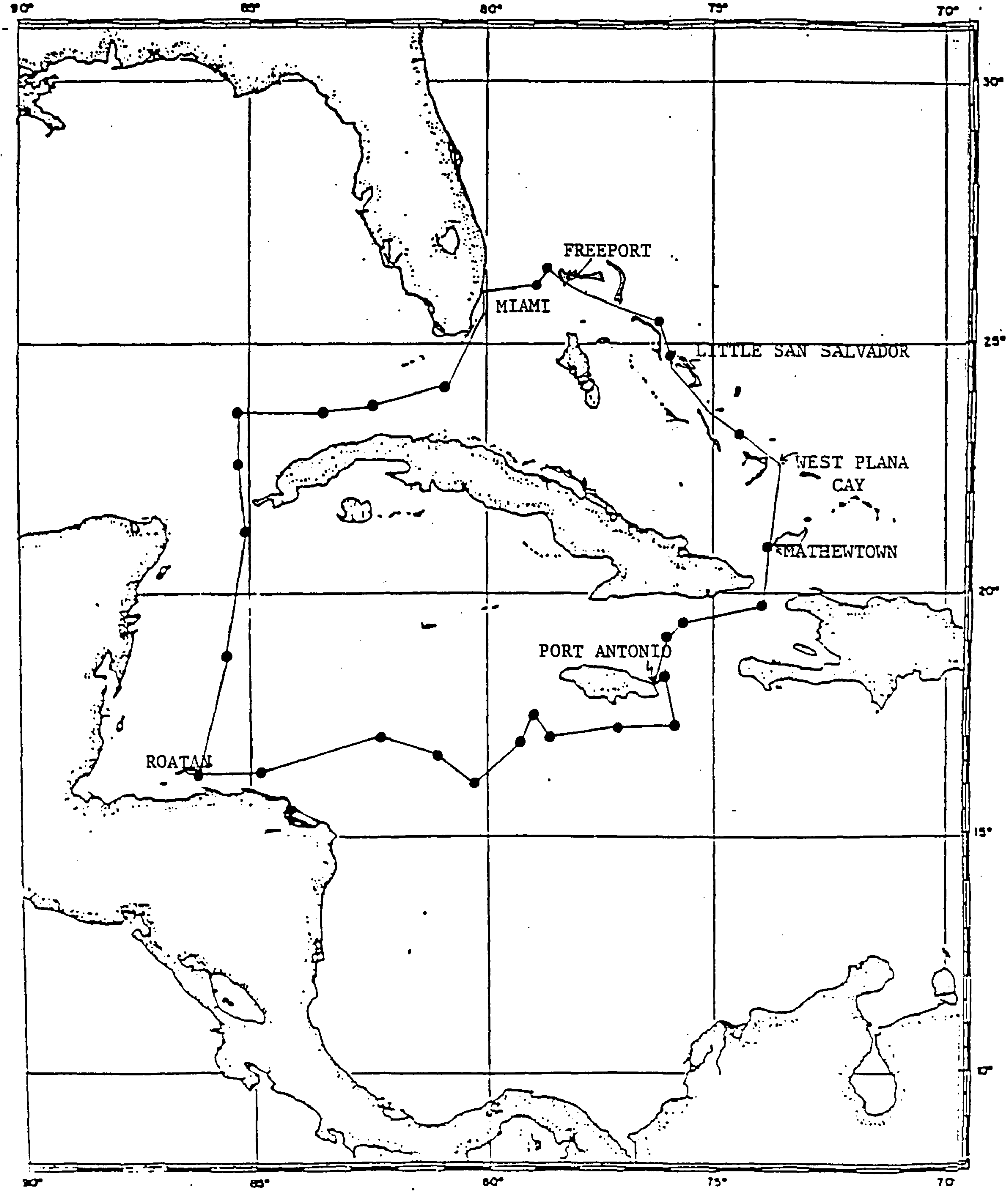


Figure 1. Cruise track of SSV CORWITH CRAMER cruise C-104, 9 Feb.-22 March 1989. Noon positions while at sea are indicated.

TABLE 2

Ship's Complement on SSV Corwith Cramer Cruise C-104

Nautical Staff

Terry Hayward	Captain
Peter Kalajian	Chief Mate
Jim (Homer) Holm	Second Mate
Jeff Stone	Third Mate
Jim Taralli	Engineer
Ricky Lee Jones	Steward

Scientific Staff

Chuck Lea	Chief Scientist
Gretchen Rollwagen	First Assistant Scientist
Trina Abbott	Second Assistant Scientist
Carolyn Sheild	Third Assistant Scientist

Visitors

Mort Maser	Woods Hole Educational Assoc.	Leg I
Rob Nawojchik	Mystic Marine Life Aquarium	Leg I
Dian Gifford	University of Rhode Island	Leg II
Orlando Herrera Bermudez	Observer, Columbian Navy	Leg III

Students

Harry Apter, Franklin & Marshall College, Junior, American Studies
Timothy Cipriani, Connecticut College, Junior, Zoology
Jennifer Clammer, Wesleyan University, Junior, Psychology
Toby Cole, Stanford University, Senior, Biology
Joseph Couillard, Wabash College, Senior, Biology
Colleen Crowley, Mass. College of Art, B.A., Art
Elizabeth Ennis, Northwestern University, Junior, Biology
Michelle Gamache, Colgate University, Junior, Geology
Gretchen Granger, Colby College, Junior, Biology
Charles Gibbs, Bowdoin College, Sophomore, Government
Jennifer Heberer, Trinity College, Sophomore, Undeclared
Colin Kendrick, Bowdoin College, Sophomore, Undeclared
Christina Kubota, Wellesley College, Junior, Psychobiology
Todd Lang, University of Delaware, Junior, Geography
Edmund "Bill" Liddle, Boston College, Junior, History
Carolyn Lyman, University of Alaska, R.N., Nursing
Spencer Lyman, University of Utah, M.S., Human Resources Mgmt.
Terri Marsik, University of Richmond, Sophomore, Biology
Gary Matusow, University of Vermont, Junior, Geography
Richard Paullin, Cornell University, Senior, Mechanical Engineering
Elin Piorkowski, Cornell University, Sophomore, Communications
Todd Taylor, Bowdoin College, Junior, Biochemistry
Amy Vince, American University, Sophomore, Political Science

TABLE 3

Oceanography Lectures aboard SSV *Corwith Cramer* Cruise C-104

FEBRUARY			
10	F	Operation of the Bathythermograph and the Hydrowinch	Chuck Lea
12	S	Coral Reef Fishes	Rob Nawojchik
15	W	Marine Organisms of Little San Salvador	Trina Abbott Rob Nawojchik Carolyn Sheild
16	Th	The Salinometer and the Winkler Oxygen Titration	Gretchen Rollwagen
17	F	The Geologic History of Little San Salvador and West Plana Cay	Chuck Lea
20	M	Langmuir Circulation, Niskin Bottle Demonstration	Chuck Lea
21	T	Man/Marine Mammal Conflicts	Chuck Lea
22	W	Modern Oceanographic Sampling	Chuck Lea
23	Th	Introduction to the Spectrophotometer and the Fluorometer	Trina Abbott
27	M	Deep-Sea Reversing Thermometers	Carolyn Sheild
28	T	Fish Evolution and Morphology	Gretchen Rollwagen
MARCH			
2	Th	Practical Exam	
3	F	The SUPER Project	Dian Gifford
6	M	Using the Computers aboard SSV *Corwith Cramer*	Gretchen Rollwagen
7	T	Tuna Biology	Chuck Lea
8	W	Trophic Relationships of Ciliates and Flagellates	Dian Gifford
13-19		Student Project Presentations	
17	F	Final Exam	

B. Academic Program

Cruise C-104 represents the second half of the 12-week Sea Semester program. During the first six weeks, students took three courses: Oceanography, Nautical Science, and Maritime Studies. The projects which the students undertook at sea were researched and proposed during the shore component. The proposal process included both written and oral presentations.

Throughout the cruise, a 24-hour science watch was maintained by a staff member and three students. During this time, students were instructed in the use of sampling and analytical equipment. Science watch standers were responsible for maintenance of the science log, conducting scientific stations, and the routine observation and measurement of oceanographic and meteorological conditions. Analyses of water and biological samples were also completed on science watch. The responsibility of the students for these procedures was gradually increased over the duration of the cruise, culminating in each student being designated Junior Science Watch Officer (JSWO) for two or three watches. Responsibility for the efficient running of the lab and the progress of the scientific program rested with these JSWO's.

Formal instruction was given each day in a lecture. The topics covered in these lectures (Table 3) ranged from practical oceanographic sampling to presentations discussing timely or recently observed phenomena, as well as theoretical oceanographic or marine biological subjects. Examinations and student presentations were also conducted during these instructional periods. Included in the presentations were the students' project results and a short examination of the biology and ecology of a marine organism ("Creature Feature") collected or observed during the cruise.

C-104 was comprised of two three-week courses in Oceanography offered by SEA with credit transferred through Boston University. Letter grades for the shipboard courses were determined on the basis of on-watch evaluations, exams, "Creature Feature" reports, and the research project presentation and final written report.

MIXING IN THE LITTLE SAN SALVADOR LAGOON

Charles Gibbs

Abstract

The water in the lagoon of Little San Salvador was examined to determine the mixing processes taking place. Temperature, salinity, and depth measurements were taken by CTD, bucket thermometer and bottled salinity samples. Density was calculated from the temperature and salinity. Measurements were made around mid-day just before and just after the flood tides on two different days. No vertical stratification was encountered throughout the lagoon, indicating a well-mixed water column. This is probably due to tidal mixing of relatively fresh oceanic water at the east end of the lagoon with relatively salty water from the shallow peripheral coves on the northern and southern sides. This salty water is generated by evaporation to the western end of the lagoon.

A STUDY OF THE PHOSPHATE AND CHLOROPHYLL A LEVELS IN THE CENTRAL LAGOON OF LITTLE SAN SALVADOR, BAHAMAS

Jennifer Heberer and Colleen Crowley

Abstract

This study examined the phosphate concentrations and phytoplankton standing stock within a tidally flushed lagoon and just offshore of the lagoon inlet on Little San Salvador, Bahamas. Chlorophyll a measurements of plant biomass were made at ten locations within the lagoon and two locations seaward of the inlet. Fourteen phosphate measurements were taken at the surface in the lagoon and offshore of the inlet and six were made one meter from the bottom within the lagoon.

Offshore values and within lagoon values were both very low and suggested little difference between the two environments. Higher phosphate values were recorded near the bottom close to the confluence of the central lagoon with a peripheral pond (Long Cay Cove). These coincided with the highest (although still low) values of chlorophyll a.

It is thought that the turbulence of tidal mixing and convergence of water near a sand bar at this location contributed to these relatively elevated values. Land runoff does not appear to make a large contribution to either phosphate concentrations or the standing crop within the lagoon.

SPONGE ECOLOGY, MORPHOLOGY, AND COMMENSALISM IN WEST BAY AND IN THE WESTERN CENTRAL LAGOON OF LITTLE SAN SALVADOR, BAHAMAS

Gretchen Granger

Abstract

Sponges were collected from three areas of Little San Salvador: West Bay, the open Central Lagoon, and the mangrove root zone at the periphery of the lagoon. Specimens were examined for associated organisms, porosity and spicule type. Observations were made about the sponges' environments, their morphologies and their structures. While the same kinds of sponge were found in both West Bay and the open lagoon, there were differences in sponge size and morphology. Bigger sponges with larger pores, and upright, stiffer structures were found in the high energy West Bay, while smaller sponges with soft, rounded structures, raised oscula, and small pores were found in the lower energy western Central Lagoon. Associate organisms were relatively consistent in types between West Bay and the Central Lagoon, but absent in mangrove root encrusting samples. Specimens of amphipods and polychaetes dominated the fauna associated with the sponges. The relatively small pore size and soft consistency of mangrove sponges may account for the lack of associated fauna.

THE PHYSICAL AND BIOLOGICAL CHARACTERISTICS OF THE INLET TO LITTLE SAN SALVADOR LAGOON AND THEIR ROLE IN DETERMINING THE POPULATION OF STROMBUS GIGAS

Colin Kendrick

Abstract

The physical and biological characteristics of the inlet to Little San Salvador Lagoon were investigated in relationship to the population and distribution of *Strombus gigas*, the queen conch. The lagoon inlet area was subdivided into six station areas where temperature, salinity, and sediment size (as an indicator of current) were measured, and a general characterization of biological life such as plants, conch predators and competitors was made. The number and size of conchs were recorded with a determination of each animal as juvenile or mature.

All of the juvenile conchs in this study (3), and reported from the last nine years, were located on a flat seagrass bed just westward of the inlet's main current channel. This area is characterized by proximity to the main channel, but is subject to lower current velocities and has approximately 60% of coverage by *Thalassia testudinum*. Mature conch were collected in proximity to the main channel of the lagoon. This distribution and the structure of the inlet suggest that a significant amount of input into the existing conch population occurs in the form of pelagic larvae from external sources which are carried to the lagoon by the current.

THE INFLUENCE OF SHORE GRADIENT AND SEDIMENT TYPE ON RED MANGROVE (*RHIZOPHORA MANGAL*) DISTRIBUTION IN LITTLE SAN SALVADOR AND WEST PLANA CAY, BAHAMAS

Harry Apter

Abstract

Measurements of shore elevation gradients and sediment size and composition were made in beach, karst, and a sheltered environment in Little San Salvador, and a sheltered environment in West Plana Cay, Bahamas.

Transects and sieving showed that red mangroves are found in gently sloping areas that have high mud and peat soils on both islands.

Seedlings, but no mature mangroves, were present in the beach environment. No mangroves were observed in a sand environment next to a steeply rising carbonate embankment on Little San Salvador. The mangroves on West Plana Cay were growing behind the dunes in an area subject to periodic inundation.

It appears that gradual coastal rises and fine sediment allow mangrove seedlings to penetrate the substrate and begin root formation, thus creating a more suitable environment for future seedling and adult plants.

This study shows that shore gradient and substrate are two major factors influencing where mangroves can be found in Little San Salvador and West Plana Cay.

BEACHES OF LITTLE SAN SALVADOR ISLAND AND WEST PLANA CAY AS POSSIBLE INDICATORS OF RECENT RAPID SEA LEVEL RISE

Todd E. Taylor

Abstract

Beaches on Little San Salvador and West Plana Cay were examined for evidence of current erosion caused by a recent rise in global sea level. Transects along selected beach areas from the back shore vegetation toward mean low water were used as areas of examination to look for low dry sand areas, cliffing of backshore terrain, undercut vegetation, and exhumed beach rock. Aragonite-coated beach rock was used as the principal evidence for long-term beach erosion as distinguished from seasonal storm-wave induced erosion. These observations indicated that part of Little San Salvador and most of West Plana Cay showed strong evidence of erosion caused by a recent surge in local sea level. The source of sand for each island was thought to play some role in the maintenance of the beaches. The larger platform extending to windward at Little San Salvador may counteract erosion due to rising sea level by supplying the island with new sediment.

COMPARISONS OF GEOSTROPHIC FLOW IN THE WINDWARD PASSAGE AND THE CARIBBEAN SEA BETWEEN JAMAICA AND ROATAN

Terri J. Marsik

Abstract

The geostrophic equation was used to estimate the water volume transport across two transects in the Caribbean Sea. The first transect was south of Windward Passage but did not sample the entire water flow through the passage. Net volume transported was 1.71×10^6 M^3/sec to the southwest. This figure is low in comparison with literature values. The difference was attributed to Ekman drift to the northeast in the upper 100m, failure to measure the entire passage, and by choosing a level of no motion at 1000m while the full depth of the passage is approximately 2000m. The second transect was between Jamaica and Roatan where the northwestern Caribbean transport above 500m was calculated to be 8.16×10^6 M^3/sec. This is in general agreement with literature values.

THE WATER MASSES OF THE UPPER 1000 METERS OF THE WESTERN CARIBBEAN

Richard C. Paullin

Abstract

Temperature, salinity, oxygen and phosphate measurements were taken in the upper 1000 meters of the water column along a cruise track from north of the Windward Passage to the Honduran shelf. Analyses of these properties revealed the distribution and mixing of Subtropical Underwater, 18 ^{o}C Sargasso Sea Water, Tropical Atlantic Central Water and Antarctic Intermediate Water in the western Caribbean Sea. Tropical Atlantic Central Water and Antarctic Intermediate Water were determined to be the most clearly identifiable water masses north of the Honduran shelf, with some Subtropical Underwater, and only small quantities of 18 ^{o}C Sargasso Sea Water, present. It appears that mixing of the flow from the Windward Passage with the southern Caribbean Current causes the gradual elimination of the 18 ^{o}C Sargasso Sea Water and the reduction in quantity of the Subtropical Underwater.

WATER FLOW ON THE PEDRO BANK AS DESCRIBED BY ISOTHERMS

Elizabeth Ennis

Abstract

Pedro Bank is a relatively shallow carbonate bank rising from the Caribbean Sea floor southwest of Jamaica. The influence of Pedro Bank on the temperature structure of the upper water column was examined by a series of bathythermograph and CTD measurements taken to windward on top of and to leeward of the Bank. At the windward margin of the structure, isotherms rose about 10m suggesting topographically-induced upwelling. Stratification was absent on top of the bank indicating mixing of the water column through wind or current-induced turbulence. Re-establishment of the isotherms occurred on the leeward side with the increasing depth. The variation in the depth of isotherms downstream of the Bank suggested that eddies might be generated by the structure. The temperature data were consistent with aspects of the chlorophyll _a_ distribution around the Bank.

CHLOROPHYLL A AND PHOSPHATE ABUNDANCE OVER PEDRO BANK: AN INVESTIGATION INTO THEIR DISTRIBUTION AND WATER CIRCULATION PATTERNS

Christina Kubota

Abstract

The influence of Pedro Bank, a shallow carbonate platform southwest of Jamaica, on chlorophyll *a* and phosphate distributions was investigated. Samples from five hydrocasts taken to windward and to leeward of the bank top were analyzed and compared with temperature measurements indicating water movement over the bank. On the windward (up current) side, there was a chlorophyll *a* maximum at 100m. In the water above the bank, relatively low values of chlorophyll *a* were found except at two locations where concentrations rose near the bottom of the water column. Leeward of the bank, the chlorophyll *a* maximum was at 100m but, in contrast to measurements on the windward side, relatively high values were also recorded at 50m. Phosphate values were generally low over the bank except near the bottom of the leeward side of the bank.

Temperature profiles indicated that relatively stratified water occurred on the windward side of the bank while upwelling, turbulence, and wind mixing occurred over the bank. Leeward of the bank, the stratification reappeared. This mixing may cause benthic nutrient resuspension which would result in chlorophyll *a* enrichment near the bottom of the bank and downstream. An increase in the standing stock of phytoplankton could lead to higher zooplankton and fish biomass near the bank.

COMPOSITION AND GRAIN SIZE ANALYSIS OF THE INORGANIC CARBONATE SEDIMENTS ON THE LEEWARD SLOPE OF PEDRO BANK, SW CARIBBEAN

Michelle Gamache

Abstract

Pedro Bank is a submerged platform, south of Jamaica, characterized by a sedimentary lobate lens extending leeward of the plateau. This study examined both bank top and lens for sediment composition and grain size. The material was collected with a Shipek bottom grab.

The sediments on top of the bank were large grains representing fragments of shells from benthic organisms, particularly *Halimeda*, worm tubes and foraminifera. Immediately off-bank on the leeward side, the sediment size dropped and the composition was characterized by both benthic and pelagic organisms. Pteropod shells and *Globigerina* tests characterized the pelagic contribution. Some increase in the pelagic contribution was noted further away from the bank on the lobe.

The velocity of the current controls the sediment size on the bank top with the strong current suspending the finer particles and depositing them off the bank top to leeward in calmer water. The occurrence of pelagic biogenic sediment close to the bank margin may be a result of bank-enhanced water column standing stock of phytoplankton.

ROSALIND BANK SEDIMENTS: A SIZE DISTRIBUTION AND PRECISION DEPTH RECORDER SURVEY

Spencer Lyman

Abstract

Sediment size distribution along the SE flank, across the bank top, and down the lee side of Rosalind Bank, was examined using sediment samples recovered by Shipek grab. Fine sand dominated samples collected from 1005-440 m on the windward side of the bank. Coarser material was collected from 210 m to the bank top. Precision depth records of the Rosalind Bank indicated slumped mounds and a slope of 9 to 1 which was felt to be more consistent with slow sediment accumulation rather than a scouring current.

PHOSPHATE CONCENTRATIONS FOUND IN THE WATERS SURROUNDING <u>SARGASSUM</u> IN THE SOUTHWEST SARGASSO SEA AND NORTHWEST CARIBBEAN SEA

Jennifer Clammer

Abstract

The nutrient regime surrounding the floating algae *Sargassum Spp.* was investigated at five stations along the C-104 cruise track. At each station, a series of three phosphate samples were taken: the initial one was of the surface water; the second, a control, was of the surface water after sitting for five hours in a 4-liter bucket; and the third one was of water and *Sargassum* after sitting for five hours. Analysis of the samples revealed that the water with the *Sargassum* had higher phosphate concentrations--as much as two orders of magnitude. This may reflect the metabolism of the biotic community that exists on the *Sargassum* weed. If these higher phosphate concentrations are a result of the epifauna on the weed, then a symbiotic algae/animal relationship may exist. The epifaunal life benefits the *Sargassum* through increasing the nutrient level in the water immediately surrounding the algae while, in return, the animals receive a substrate on which they can live.

A QUANTITATIVE AND QUALITATIVE STUDY OF SARGASSUM IN THE CARIBBEAN AND SARGASSSO SEA

Bill Liddle

Abstract

The abundance of pelagic *Sargassum Spp.* was measured in the southwestern Sargasso Sea and northwestern Caribbean Sea. Twenty neuston tows collected an average of .05 g/m^2, which is well within the range of mass recorded from previous SEA collections along this cruise track. This study also investigated the morphology of the *Sargassum natans* and the *Sargassum fluitans* in order to better describe differences between and among the two species. Measurements were made of leaf length, leaf width, distance between the serrations, bladder length, bladder height, serration height, serration width, and frequency of occurrence of spines on the bladders. Leaf length-to-width ratios appeared to separate the two species. Smaller differences in this ratio between the Sargasso Sea and Caribbean collections of *S. natans* suggest regional differences in that species.

SIZE DISTRIBUTION OF PLEUSTONIC GELATINOUS ZOOPLANKTON IN THE SARGASSO SEA AND CARIBBEAN SEA

Ted Couillard

Abstract

Size and population densities of Porpita porpita--a pleustonic, gelatinous zooplankton recovered from neuston tows, were examined along the cruise tract of C-104 in the southern Sargasso Sea and Western Caribbean Sea. A t-test revealed no significant difference in size between Porpita recovered from the Sargasso Sea and those from the Caribbean Sea. The majority of all Porpita recovered were found in a small area just south of the Windward Passage. These data suggest that the Porpita of the southern Sargasso Sea and northern Caribbean Sea are of one population, and the northern Caribbean Sea may be supplied with Porpita from the Sargasso Sea.

IS CHLOROPHYLL *A* A GOOD INDICATOR OF *HALOBATES* DISTRIBUTION?

Gary Matusow

Abstract

The neustonic marine insect *Halobates micans* was collected with neuston tows over the cruise track of C-104. The specimens were sexed when possible and the larval stage determined. Surface samples were taken approximately every twenty miles and the chlorophyll *a* concentration measured. The chlorophyll *a* concentration was then graphed against the log readings between Grand Inagua Island, Bahamas and the island of Roatan, Honduras. *H. micans* were plotted on the same graph. A pattern of elevated chlorophyll *a* concentrations with higher *Halobates* concentrations was suggested. The correlation coefficient (r^2) was .765. The chlorophyll *a* concentration may be an indicator of *Halobates* abundance if the plant material is responsible for increased zooplankton, especially the neustonic zooplankton which serves as prey for the *Halobates*. Analysis of larval stages suggests no specific breeding period of *Halobates* in Caribbean waters.

A STUDY OF THE FACTORS ASSOCIATED WITH ABUNDANCE AND DISTRIBUTION OF EUTHECOSOMATOUS PTEROPODS IN THE BAHAMAS AND CARIBBEAN

Toby Cole

Abstract

This study examined the vertical and horizontal distribution of euthecosomatous pteropods in the Bahamas and Caribbean Sea and investigated abundances of individual species with physical parameters and zooplankton density. Four meter net stations were made, towing at 100m, 200m, and 400m. In addition, neuston tows were carried out to supplement the data all along the cruise track. Specimens of 1114 pteropods were collected, with 19 species represented. The major species found were _Limacina inflata_, _Creseis acicula_, _Styliola subula_, _Cuvierina columnella_, _Diacria quadridentata_ as well as species of Cavolinidae. Abundance and diversity were calculated for each tow. Zoogeographic distribution and temperature ranges of individual species from the literature were confirmed. Many species were warm water cosmopolites with some species showing tropical or subtropical distribution. A negative correlation was suggested with depth, with most species occurring shallower than 100m. Positive correlations were suggested between pteropod abundance, temperature, proximity to land, and salinity.

DISTRIBUTION PATTERNS OF THE SPINY LOBSTER LARVAE (PHYLLOSOMA) AND EEL LARVAE (LEPTOCEPHALI) IN THE WATERS OF THE CARIBBEAN AND BAHAMAS

Carolyn Lyman

Abstract

The occurrence and distribution of spiny lobster (phyllosoma) and eel (leptocephali) larvae were examined on a cruise through the Bahamas, Windward Passage and northwestern Caribbean. Samples from meter and neuston nets were sorted. Seven phyllosoma and six eels were collected. The Phyllosoma were in the mid to late stage (6-10) of larval development. The absence of early stages was attributed to lack of sampling in close proximity to the nearshore waters, the source of the larvae. Leptocephali were from four families: Ophichthidae, Nemichthyidae, Muraenidae and Congridae. Diel vertical migration occurs in both eel and lobster larvae and accounted for the occurrence of these larvae in night tows only.

ZOOGEOGRAPHY OF MESOPELAGIC MYCTOPHIDAE IN THE SOUTHWEST SARGASSO AND CARIBBEAN SEAS

Tim Cipriani

Abstract

The pattern of water entering into the Caribbean Sea area from the Windward Passage, and passages within the Antillean Island Arc, was examined as an explanation for Myctophid zoogeography in the Caribbean Sea region. There are two major source waters outside the Caribbean Sea; the North Atlantic Subtropical Region (NASTR) water to the northeast of the Windward Passage which includes the Sargasso Sea, and the Atlantic Tropical Region (ATR) water which lies east and south of the Antillean Island Arc and includes the extreme southern portion of the North Atlantic Gyre. NASTR water has subtropical Myctophid species associated with it, and ATR water has tropical species. Myctophids which dwell in both waters come under the category of tropical-subtropical species.

Sixty-two specimens of Myctophidae, compromising seven genera and eleven species, were collected in eight night-time neuston tow stations along the cruise track (C-104) of SSV _Corwith Cramer_. Tropical species of Myctophidae were found in waters of ATR origin, and tropical-subtropical species were found in waters of both NASTR and ATR origin. The neuston tows failed, however, to yield any subtropical Myctophid species at any point within the Caribbean Sea region.

Three tropical species of _Myctophum_, _affine_, _M. aspersum_, and _M. obtusirastra_, were found in the Caribbean Sea in water of

ATR origin along with four tropical-subtropical species. Tropical-subtropical species of Myctophidae were found among ATR and NASTR waters circulating into the Caribbean Sea. The association of certain myctophid species with a particular source water allows a relationship to be drawn between circulation patterns and corresponding myctophid distribution.

A STUDY OF AND COMPARISON BETWEEN PELAGIC AND TERRESTRIAL PLASTICS IN THE SOUTHWEST SARGASSO SEA AND THE NORTHERN CARIBBEAN

Elin Piorkowski and Todd Lang

Abstract

Plastic pollution is a threat to marine life and is also aesthetically displeasing. Neuston nets were used to sample the concentration of pelagic plastic along the cruise track in the southwestern Sargasso Sea and northwestern Caribbean. Qualitative and quantitation observations were made to determine the concentration and distribution of plastics along the beaches of Little San Salvador and West Plana Cay in the Bahamas and Roatan, Honduras. Observations were made generally on the beach and in detailed five meter by five meter plots with quantitative samples evaluated from 30cm x 30cm sand samples.

The concentration of pelagic plastics was higher in the southwestern Sargasso Sea (763.9 pieces per km^2) and less in the Northern Caribbean Sea (263.9 pieces per km^2). Beach samples indicated an average of 69.5 pieces per m^2 on the windward side of the islands surveyed and an average of 1.9 pieces per m^2 on the leeward side of these islands.

The results indicate a higher concentration of plastics in the southwestern Sargasso Sea than in the Northern Caribbean Sea which supports the idea of the central gyre in the Sargasso Sea acting to concentrate plastic debris. Comparison with previous collections suggests that a decrease in the amount of plastics was observed both in the oceans and on the beaches sampled on cruise C-104.

THE CONCENTRATION AND DISTRIBUTION OF PELAGIC TAR IN THE SARGASSO AND CARIBBEAN SEAS AND ON THE WINDWARD BEACHES OF LITTLE SAN SALVADOR AND WEST PLANA CAY

Amy Vince

Abstract

Pelagic tar was collected by neuston net in the southwestern Sargasso Sea and northwestern Caribbean and beach samples of tar were collected from Little San Salvador and West Plana Cay. Seventeen of twenty neuston tows (85%) collected tar and an average of 7.73 mg/m^2 of tar was calculated for the waters sampled. Generally higher values of beach tar were found on the windward shore of West Plana Cay (14-33 mg/m^2) than on the windward side of Little San Salvador (12-13 mg/m^2). The Little San Salvador values are generally higher than the collection made on W-87 but the West Plana Cay concentrations were considerably less than those made on W-86. The results do not support the hypothesis of a marked decrease in marine tar concentrations.

APPENDIX A

C-104 Noon and Midnight Positions

Date	Time	Log	Latitude	Longitude
02/10/89	0000	26.9	26.15	79.52
02/10/89	1200	42.6	26.10	78.85
02/11/89	0000	118.8	26.33	78.74
02/11/89	1200	148.4	26.50	78.77
02/12/89	0000	233.6	25.68	77.42
02/12/89	1200	299.3	25.45	76.18
02/13/89	0000	338.6	25.02	76.02
02/15/89	0000	410.4	24.08	75.83
02/15/89	1200	465.7	24.34	75.72
02/16/89	0000	523.2	23.66	75.23
02/16/89	1200	601.7	23.12	74.52
02/17/89	0000	681.5	22.91	73.94
02/20/89	0000	789.4	21.86	73.66
02/20/89	1200	844.0	20.93	73.75
02/21/89	0000	851.2	20.85	73.96
02/21/89	1200	914.2	19.78	73.87
02/22/89	0000	954.4	19.67	73.83
02/22/89	1200	984.1	19.53	74.65
02/23/89	0000	993.3	19.53	74.85
02/23/89	1200	1065.3	19.25	76.07
02/24/89	0000	1093.1	19.31	76.32
02/27/89	0000	1149.3	18.80	76.57
02/27/89	1200	1205.5	18.26	76.26
02/28/89	0000	1255.8	18.22	76.07
02/28/89	1200	1314.3	17.14	75.86
03/01/89	0000	1319.8	17.03	76.39
03/01/89	1200	1354.0	17.10	77.20
03/02/89	0000	1370.1	17.15	77.66
03/02/89	1200	1427.5	17.04	78.52
03/03/89	0000	1461.1	17.58	78.71
03/03/89	1200	1495.3	17.55	79.00
03/04/89	0000	1540.0	17.29	79.00
03/04/89	1200	1546.9	16.90	79.36
03/05/89	0000	1612.3	16.32	79.75
03/05/89	1200	1641.1	16.00	80.36
03/06/89	0000	1671.2	16.47	80.57
03/06/89	1200	1705.7	16.78	81.19
03/07/89	0000	1749.9	17.00	82.00
03/07/89	1200	1771.9	17.00	82.33
03/08/89	0000	1838.3	17.00	83.78
03/08/89	1200	1903.4	16.20	84.90
03/09/89	0000	1967.5	16.08	85.86
03/10/89	0000	2016.3	16.09	85.85
03/13/89	1200	2016.6	16.37	86.15
03/14/89	0000	2088.2	17.33	85.70
03/14/89	1200	2178.4	18.79	85.53
03/15/89	0000	2252.2	20.04	85.03
03/15/89	1200	2316.5	21.09	85.02
03/16/89	0000	2388.6	22.00	85.20
03/16/89	1200	2426.7	22.49	85.33
03/17/89	0000	2445.4	22.87	85.49

Date	Time	Log	Latitude	Longitude
03/17/89	1200	2503.6	23.66	85.25
03/18/89	0000	2556.9	23.60	84.61
03/18/89	1200	2594.9	23.52	83.57
03/19/89	0000	2640.3	23.95	82.88
03/19/89	1200	2686.7	23.85	82.46
03/20/89	0000	2749.5	23.96	81.71
03/20/89	1200	2820.6	24.07	81.00
03/21/89	0000	2881.6	24.45	80.29

APPENDIX B

C-104 Station Summary Data

Station #	Type of Deployment	Date	Time	Log	Latitude	Longitude
C-104-1	Nat	02/10/89	1202	74.5	26.10	78.80
C-104-2	Nat	02/11/89	0011	118.9	26.30	78.70
C-104-3	Nab	02/12/89	2355	233.6	25.70	77.40
C-104-4	Nab	02/12/89	1200	300.6	25.40	76.20
C-104-5	CTD	02/12/89	2127	334.3	25.10	76.00
C-104-6	Nab	02/15/89	0000	401.4	24.10	75.80
C-104-7	Nab	02/20/89	0008	769.6	21.80	73.70
C-104-8	H,MN123,Nab	02/20/89	1715	852.2	20.90	73.80
C-104-9	Nab	02/21/89	1203	914.2	19.80	73.90
C-104-10	CTD	02/21/89	1810	936.7	19.70	73.50
C-104-11	CTD	02/22/89	0200	957.7	19.50	74.20
C-104-12	CTD	02/22/89	1133	984.1	19.40	74.60
C-104-13	Nab	02/22/89	1319	984.2	19.50	74.60
C-104-14	MN123,Nab	02/22/89	2100	990.0	19.50	74.70
C-104-15	Nab	02/27/89	0030	1152.0	18.80	76.60
C-104-16	Nab	02/27/89	1209	1205.6	18.30	75.30
C-104-17	Na	02/28/89	0006	1255.9	18.20	76.10
C-104-18	H,MN123,Nab,P,CTD	02/27/89	1200	1314.2	17.10	75.80
C-104-19	H,CTD	03/01/89	0720	1340.7	16.80	77.20
C-104-20	H,CTD	03/01/89	1540	1368.8	17.10	77.20
C-104-21	H,CTD	03/01/89	2100	1380.3	17.40	77.50
C-104-22	H,CTD	03/02/89	0150	1397.0	17.10	77.80
C-104-23	H,CTD,S	03/02/89	0900	1422.1	17.10	78.20
C-104-24	SHIPEK	03/02/89	1915	1443.4	17.40	78.60
C-104-25	H,CTD,S	03/02/89	2215	1457.1	17.50	78.70
C-104-26	H,CTD,S	03/03/89	0135	1476.6	17.70	78.80
C-104-27	SHIPEKab	03/03/89	0540	1476.6	17.80	78.80
C-104-28	H,CTD,S	03/03/89	1100	1495.3	17.50	79.00
C-104-29	H,CTD,S,Nab	03/03/89	2345	1540.0	17.30	78.90
C-104-30	SHIPEKab	03/04/89	0400	1544.8	17.20	79.00
C-104-31	CTD	03/04/89	0815	1546.9	17.20	79.20
C-104-32	Nab	03/04/89	1222	1563.6	17.00	79.40
C-104-33	MN123,Nab	03/04/89	2130	1610.8	16.30	79.70
C-104-34	SHIPEKa-i	03/05/89	1010	1638.9	16.00	80.20
C-104-35	SHIPEKa-d	03/05/89	2230	1664.9	16.30	80.50
C-104-36	Nab	03/06/89	1210	1705.9	16.80	81.20
C-104-37	H,CTD,Nab	03/07/89	0545	1771.9	17.00	82.30
C-104-38	Nab,CTD	03/14/89	1155	2178.2	18.80	85.70
C-104-39	Nab	03/15/89	2350	2252.3	20.00	85.20
C-104-40	Nab	03/15/89	1220	2318.8	21.10	85.10
C-104-41	Nab	03/16/89	0055	2393.8	22.10	85.20
C-104-42	Na	03/16/89	1214	2426.8	22.50	85.40
C-104-43	H,CTD	03/16/89	1611	2436.0	22.70	85.30
C-104-44	Nab	03/17/89	0007	2445.4	22.90	85.50

Abbreviations

N = Neuston net; CTD = Conductivity Temperature Depth; H = Hydrocast; MN = Meter Net; Shipek = Shipek sediment grab; a, b, etc. indicate separate collections by a sampling device.

APPENDIX C

C-104 BT Data Summary

Station #	Date	Time	Log	Latitude	Longitude	Surface Temp
BT-001	02/10/89	0545	41.9	26.10	79.20	25.3
BT-002	02/10/89	1525	90.2	26.00	78.50	25.4
BT-003	02/10/89	2025	109.4	26.20	78.50	25.2
BT-004	02/11/89	0327	126.3	26.30	78.80	25.3
BT-005	02/11/89	1455	171.0	26.30	78.50	25.8
BT-006	02/11/89	1750	193.3	26.00	78.10	24.9
BT-007	02/12/89	0130	236.1	25.70	77.40	24.0
BT-008	02/12/89	0517	259.1	25.80	76.90	24.6
BT-009	02/12/89	0840	279.2	25.60	76.50	24.7
BT-010	02/12/89	1142	297.5	25.50	76.30	24.8
BT-011	02/12/89	1705	320.8	25.00	76.10	24.8
BT-012	02/14/89	1316	372.6	24.50	75.90	25.0
BT-013	02/15/89	1928	507.9	23.92	75.39	24.7
BT-014	02/16/89	0120	532.0	23.56	75.13	24.6
BT-015	02/16/89	0535	562.3	23.22	74.82	25.0
BT-016	02/19/89	2130	780.4	22.00	73.59	25.9
BT-017	02/20/89	0330	799.6	21.60	73.64	26.1
BT-018	02/20/89	0830	823.9	21.24	73.66	25.9
BT-019	02/20/89	1511	844.9	20.96	73.71	26.5
BT-020	02/21/89	0556	882.1	20.35	73.98	25.6
BT-021	02/21/89	0850	902.8	20.13	73.95	26.4
BT-022	02/21/89	1500	924.3	19.73	73.79	27.2
BT-023	02/21/89	2218	947.8	19.70	73.66	27.0
BT-029	02/22/89	0849	971.1	19.47	74.58	26.5
BT-030	02/23/89	0030	998.2	19.52	74.93	26.7
BT-031	02/23/89	0332	1018.2	19.50	75.29	26.2
BT-032	02/23/89	0710	1037.8	19.47	75.55	26.7
BT-033	02/23/89	1135	1064.7	19.24	76.07	26.7
BT-034	02/23/89	2230	1086.1	19.05	76.30	26.5
BT-035	02/24/89	0221	1109.3	18.25	76.47	26.7
BT-036	02/26/89	1945	1125.4	18.42	76.52	26.4
BT-037	02/27/89	2330	1146.5	18.74	76.57	26.4
BT-038	02/27/89	0340	1167.5	18.63	76.43	26.4
BT-039	02/27/89	0750	1188.6	18.29	76.39	26.4
BT-040	02/27/89	1220	1205.6	18.26	75.31	26.6
BT-041	02/27/89	2130	1244.7	18.27	76.26	26.5
BT-042	02/28/89	0320	1266.1	18.02	76.04	26.3
BT-043	02/28/89	0735	1285.7	17.66	75.76	26.3
BT-044	02/28/89	1341	1313.5	17.34	75.87	26.4
BT-045	03/01/89	0650	1340.5	16.81	77.15	26.2
BT-046	03/01/89	1135	1354.0	17.10	77.10	26.3
BT-047	03/01/89	1331	1362.2	17.10	77.27	25.4
BT-048	03/01/89	1706	1370.3	17.15	77.27	26.3
BT-049	03/01/89	1825	1374.1	17.19	77.35	26.4
BT-050	03/01/89	1850	1374.8	17.20	77.37	26.3
BT-051	03/03/89	0045	1465.5	17.60	78.80	26.3
BT-052	03/03/89	0510	1473.9	17.80	78.80	26.3
BT-053	03/03/89	0915	1486.1	17.70	79.00	26.2
BT-054	03/03/89	1456	1503.5	17.30	79.00	26.4
BT-055	03/03/89	1615	1509.6	17.30	79.00	26.3
BT-056	03/03/89	1700	1514.1	17.10	79.00	26.3

C-104 BT Data Summary

Station #	Date	Time	Log	Latitude	Longitude	Surface Temp
BT-057	03/03/89	1800	1519.4	17.10	79.00	26.4
BT-058	03/03/89	2057	1527.0	17.00	79.00	26.2
BT-059	03/03/89	2155	1533.6	17.20	79.00	26.3
BT-060	03/04/89	0950	1545.6	17.22	79.10	26.2
BT-061	03/04/89	1143	1561.4	17.03	79.25	26.4
BT-062	03/04/89	1500	1574.9	16.67	79.67	26.5
BT-063	03/04/89	1640	1584.0	16.63	79.48	26.5
BT-064	03/04/89	1925	1602.8	18.15	79.65	26.5
BT-065	03/05/89	0103	1615.5	16.28	79.75	26.4
BT-066	03/05/89	0415	1625.9	16.10	79.80	26.2
BT-067	03/06/89	0740	1698.0	16.80	81.03	26.4
BT-068	03/06/89	1350	1708.0	16.75	81.20	26.7
BT-069	03/06/89	1807	1727.7	16.85	81.68	26.7
BT-070	03/06/89	2355	1749.6	17.01	82.05	26.4
BT-071	03/07/89	0515	1770.3	17.03	82.35	26.4
BT-072	03/07/89	1710	1797.6	17.33	83.81	26.4
BT-073	03/07/89	1920	1813.1	17.02	83.41	26.2
BT-074	03/07/89	2315	1834.8	17.01	83.83	26.3
BT-075	03/08/89	0326	1855.7	16.95	84.10	26.2
BT-076	03/08/89	0825	1878.3	16.23	82.53	26.2
BT-077	03/08/89	1145	1901.2	16.22	84.85	26.2
BT-078	03/09/89	0245	1986.0	16.23	86.15	25.7
BT-079	03/09/89	0615	2009.0	16.25	86.49	25.9
BT-080	03/13/89	1406	2032.5	16.40	86.04	27.7
BT-081	03/13/89	1624	2046.5	16.62	85.97	26.3
BT-082	03/13/89	2030	2071.2	17.02	85.83	25.8
BT-083	03/14/89	0050	2094.9	17.42	85.67	25.9
BT-084	03/14/89	0400	2115.4	17.77	85.52	25.9
BT-085	03/14/89	0641	2135.7	18.10	85.40	26.1
BT-086	03/14/89	0900	2155.9	18.41	85.63	26.0
BT-087	03/14/89	1454	2182.2	18.80	85.66	26.3
BT-088	03/14/89	1732	2201.8	19.13	85.55	26.3
BT-089	03/14/89	2010	2221.5	19.41	85.46	26.2
BT-090	03/14/89	2226	2240.9	19.32	85.30	26.2
BT-091	03/15/89	0310	2263.5	20.10	85.25	26.2
BT-092	03/15/89	0630	2284.8	20.53	85.75	25.8
BT-093	03/15/89	0950	2304.6	20.90	85.20	26.0
BT-094	03/14/89	1423	2326.0	21.07	85.05	26.1
BT-095	03/15/89	1723	2346.1	21.42	85.18	26.0
BT-096	03/15/89	2050	2367.5	22.78	85.14	26.0
BT-097	03/15/89	2352	2387.6	22.30	85.21	26.0
BT-098	03/16/89	0423	2407.9	22.25	85.24	25.1
BT-099	03/16/89	1120	2427.1	22.60	85.16	26.0
BT-100	03/17/89	0308	2456.0	22.93	85.44	25.9
BT-101	03/17/89	0720	2476.1	23.00	85.33	25.8
BT-102	03/17/89	0950	2491.8	23.43	85.33	25.7
BT-103	03/17/89	1440	2513.0	23.64	85.10	26.0
BT-104	03/17/89	1800	2527.2	23.13	85.20	25.2
BT-105	03/18/89	0510	2561.2	23.51	84.41	25.9
BT-106	03/18/89	0925	2580.9	23.50	84.00	25.7
BT-107	03/18/89	1247	2599.5	23.52	83.48	25.3

C-104 BT Data Summary

Station #	Date	Time	Log	Latitude	Longitude	Surface Temp
BT-108	03/18/89	1852	2619.4	23.58	82.95	25.9
BT-109	03/18/89	2140	2628.6	23.66	82.88	25.8
BT-110	03/18/89	2246	2635.0	23.83	82.83	25.8
BT-111	03/18/89	2326	2638.1	23.92	82.83	25.5
BT-112	03/19/89	0545	2658.1	23.66	82.60	25.7
BT-113	03/19/89	0740	2664.7	23.48	82.35	25.2
BT-114	03/19/89	0955	2675.5	23.73	82.41	25.7
BT-115	03/19/89	1050	2680.5	23.67	82.39	25.7
BT-116	03/19/89	1150	2685.9	23.88	82.43	25.7
BT-117	03/19/89	1255	2690.7	23.95	82.46	25.6
BT-118	03/19/89	1427	2697.4	23.84	82.40	25.6
BT-119	03/19/89	1530	2703.1	23.90	82.27	25.7
BT-120	03/19/89	1645	2709.0	23.83	82.11	25.9
BT-121	03/19/89	1842	2719.6	23.74	81.95	25.5
BT-122	03/19/89	2008	2723.0	24.03	82.13	25.1
BT-123	03/19/89	2211	2739.0	24.08	81.89	25.1
BT-124	03/20/89	0200	2760.3	23.89	81.53	25.6
BT-125	03/20/89	0708	2790.5	24.21	81.31	25.8
BT-126	03/20/89	0815	2800.1	24.05	81.01	25.4
BT-127	03/20/89	0930	2807.5	24.00	81.22	24.5
BT-128	03/20/89	1130	2817.9	24.00	81.01	25.5
BT-129	03/20/89	1330	2826.4	24.31	80.71	25.5
BT-130	03/20/89	1405	2829.0	24.25	80.87	24.3

APPENDIX D

C-104 Surface Sample Summary Data

Station #	Date	Time	Log	Latitude	Longitude	Surf Temp (oC)	Bt #	Salinity (‰)	PO4 (uM/L)	Chl a (ug/L)
SS-002	02/10/89	1828	99.3	26.05	78.23	24.80	0	36.703	0.00	0.12
SS-003	02/10/89	2025	109.4	26.12	78.32	25.20	3	36.580	0.90	0.13
SS-004	02/11/89	0400	128.6	26.24	78.50	25.70	4	36.450	0.06	0.20
SS-005	02/11/89	0715	140.5	26.25	78.44	25.60	0	0.000	0.00	0.00
SS-006	02/11/89	1455	171.0	26.20	78.29	25.80	5	36.445	0.04	0.11
SS-007	02/11/89	2040	213.6	25.55	77.55	24.90	0	36.685	0.29	0.10
SS-008	02/12/89	0130	236.1	25.45	77.25	24.00	7	36.769	0.28	0.13
SS-009	02/12/89	0520	259.1	25.48	76.54	24.60	8	36.811	0.24	0.13
SS-010	02/12/89	0740	272.5	25.43	76.39	24.69	0	36.803	0.27	0.12
SS-011	02/12/89	0900	281.7	25.39	76.31	24.72	0	36.778	0.00	0.15
SS-012	02/12/89	1150	297.5	25.29	76.19	24.80	10	36.789	0.01	0.06
SS-014	02/12/89	1900	326.2	25.12	76.08	24.80	0	36.789	0.63	0.10
SS-015	02/14/89	2330	398.6	24.10	75.80	24.80	0	36.350	0.00	0.13
SS-016	02/15/89	0515	424.5	23.64	75.71	24.90	0	36.892	0.64	0.11
SS-017	02/15/89	0724	435.6	23.80	75.70	24.80	0	36.322	0.00	0.11
SS-018	02/15/89	1320	475.2	24.30	75.70	24.90	0	36.314	0.07	0.11
SS-019	02/15/89	1700	495.5	24.60	75.50	24.90	0	36.318	0.14	0.14
SS-020	02/15/89	2125	514.4	23.81	75.33	24.80	0	36.348	0.23	0.13
SS-021	02/16/89	0245	542.0	23.80	75.30	24.40	0	36.804		0.10
SS-022	02/16/89	0600	564.7	23.10	74.70	25.00	15	36.408	0.07	0.09
SS-023	02/16/89	0720	5724.0	23.00	74.60	24.80	0	0.000	0.00	0.00
SS-024	02/16/89	0945	587.6	22.91	74.43	24.40	0	36.743	0.26	0.12
SS-025	02/16/89	1310	610.7	23.20	74.50	25.30	0	36.507	0.03	0.05
SS-026	02/16/89	1600	6303.0	23.50	74.60	24.40	0	36.875	0.03	0.11
SS-027	02/16/89	1845	651.0	23.30	74.40	25.00	0	36.648		0.14
SS-028	02/16/89	2200	672.3	23.10	74.10	25.00	0	36.791	0.04	0.18
SS-029	02/17/89	0200	697.9	22.90	73.90	24.90	0	36.631	0.06	0.17
SS-030	02/17/89	0600	713.4	23.00	73.70	25.20	0	36.513		0.17
SS-031	02/17/89	0715	720.8	22.90	73.80	25.10	0	0.000	0.00	0.00
SS-032	02/17/89	0915	735.0	22.80	73.70	25.50	0	36.293	0.06	0.10
SS-033	02/18/89	0830	745.8	22.60	73.60	25.50	0	36.337	0.08	0.19
SS-034	02/19/89	1512	753.0	22.50	73.60	25.90	0	36.327	0.05	0.16
SS-035	02/19/89	2000	775.9	22.10	73.60	25.90	16	36.120	0.00	0.00
SS-036	02/20/89	0320	798.9	21.60	73.60	26.10	17	36.232	0.01	0.00
SS-037	02/20/89	0800	820.2	21.24	73.66	26.00	18	36.136	0.05	0.12
SS-038	02/20/89	0850	826.4	21.30	73.70	25.90	18	36.233	0.08	0.00
SS-039	02/20/89	1715	846.6	20.92	73.68	26.20	0	36.262	0.04	0.14
SS-040	02/21/89	0645	887.1	20.35	73.78	25.30	20	36.278	0.06	0.16
SS-041	02/21/89	0915	905.2	20.97	73.73	26.40	0	36.274	0.01	0.17
SS-042	02/21/89	1445	922.4	19.73	73.30	27.20	22	36.345	0.07	0.13
SS-043	02/21/89	2111	942.5	19.70	73.67	26.90	23	36.299	0.00	0.15
SS-044	02/22/89	0735	962.6	19.45	74.56	26.70	0			0.11
SS-045	02/22/89	0920	972.7	19.43	74.60	26.50	0	36.313	0.04	0.13
SS-046	02/23/89	0100	1001.1	19.55	74.78	26.70	0	36.165	0.08	0.15
SS-047	02/23/89	0500	1027.3	19.48	75.30	26.75	0	0.000	0.00	0.13
SS-048	02/23/89	0730	1040.1	19.42	75.62	26.70	32	0.000	0.03	0.16
SS-049	02/23/89	1230	1066.8	19.25	76.07	26.70	33	0.000	0.30	0.13
SS-050	02/23/89	2220	1086.2	19.60	76.32	26.50	34	0.000	0.04	0.11

C-104 Surface Sample Summary Data

Station #	Date	Time	Log	Latitude	Longitude	Surf Temp (oC)	Bt #	Salinity (%o)	PO4 (uM/L)	Chl a (ug/L)
SS-051	02/24/89	0235	1111.3	18.25	76.48	26.70	35		0.09	0.24
SS-052	02/24/89	0730	1115.6							
SS-053	03/26/89	1920	1122.8	18.35	76.46	26.40	36	36.041	0.28	0.19
SS-054	03/26/89	2305	1145.5	18.73	76.56	26.35	37	36.091	0.40	0.22
SS-055	03/27/89	0340	1167.5	18.63	76.43	26.40	38	36.071	0.06	0.16
SS-056	03/27/89	0720	1185.9	18.33	76.43	26.40	39	36.135	0.04	0.14
SS-057	03/27/89	1150	1205.4	18.26	75.26	26.50	0	36.126	0.17	0.14
SS-058	03/27/89	1745	1225.9	18.17	76.40	26.60	0	36.167	0.09	0.24
SS-059	03/27/89	2130	1244.7	18.27	76.27	26.50	41	36.108	0.31	0.20
SS-060	03/28/89	0300	1264.7	18.02	76.05	26.30	42	36.245	0.09	0.22
SS-061	03/28/89	0703	1283.3	17.66	75.96	26.00	0			
SS-062	03/28/89	0735	1285.7	17.66	75.96	26.30	43	35.963	0.26	0.16
SS-063	02/28/89	1325	1317.3	17.03	75.87	26.40	44	35.914	0.16	0.15
SS-064	02/28/89	1815	1319.3	17.10	76.17	26.70	0	0.000	0.00	0.00
SS-065	03/01/89	0620	1337.7	17.00	76.77	26.30	45	35.944	0.07	0.16
SS-066	03/01/89	0825	1340.7	16.30	77.27	26.40	0	0.000	0.00	0.00
SS-067	03/01/89	1310	1360.0	17.08	77.27	26.40	47	35.814	0.08	0.25
SS-068	03/02/89	0715	1415.6	17.08	78.08	26.10	0		0.00	0.17
SS-070	03/03/89	0610	1476.6	17.76	78.77	26.30	0	36.086	0.00	0.00
SS-071	03/03/89	0750	1477.3	17.78	79.00	26.20	0			
SS-072	03/03/89	1500	1503.9	17.37	79.04	26.40	0	36.086	0.92	0.26
SS-073	03/03/89	1610	1509.6	17.29	79.02	26.30	55	35.912	0.02	0.26
SS-074	03/03/89	1700	1514.1	17.17	79.05	26.30	56	35.912	0.29	0.30
SS-075	03/03/89	1800	1519.4	17.10	79.02	26.40	57	35.912	0.26	0.23
SS-076	03/03/89	2100	1527.2	17.05	79.08	26.20	58	35.917	0.14	0.23
SS-077	03/03/89	2200	1533.7	17.20	79.00	26.30	0	35.914		0.11
SS-078	03/04/89	0700	1544.3	17.16	79.10	26.20	0			
SS-079	03/04/89	1145	1562.1	17.00	79.25	26.00	61	36.096	2.26	0.10
SS-080	03/04/89	1640	1584.0	16.64	79.48	26.50	63	35.323	1.92	0.14
SS-081	03/04/89	1945	1602.8	16.38	79.65	26.40	0	35.628	1.07	0.12
SS-082	03/05/89	0200	1618.3	16.24	79.77	26.40	0	36.148	1.93	0.12
SS-083	03/05/89	0425	1625.9	16.10	17.80	26.20	0	36.150	0.01	0.08
SS-084	03/05/89	0720	1625.9	16.08	79.80	26.30	0			
SS-085	03/05/89	1705	1646.3	16.27	80.38	26.60	0	36.058	0.00	0.19
SS-086	03/05/89	2315	1666.0	16.37	80.52	26.50	0	35.575	0.00	0.13
SS-087	03/06/89	0245	1685.7	16.65	80.70	26.70	0	36.144	0.00	0.21
SS-088	03/06/89	0715	1646.0	16.82	80.80	26.40	0	0.000	0.00	0.00
SS-089	03/06/89	1315	1708.0	16.76	81.18	26.60	0	35.445	0.00	0.13
SS-090	03/06/89	1820	1728.5	16.35	81.68	26.70	0	36.248	0.00	0.08
SS-091	03/07/89	0001	1749.9	17.00	82.05	26.40	0	36.339	0.14	0.02
SS-092	03/07/89	0530	1771.5	17.04	82.33	26.40	0	36.223	0.01	0.13
SS-093	03/07/89	1130	1771.9	17.04	82.33	26.30				
SS-094	03/07/89	1710	1797.6	17.23	83.08	26.40	72	36.121	0.00	0.14
SS-095	03/07/89	1920	1813.1	17.20	83.34	26.20	73	36.259	0.00	0.17
SS-096	03/07/89	2315	1834.3	17.00	83.68	26.30	74	36.246	0.00	0.01
SS-097	03/08/89	0315	1855.7	16.83	84.10	26.20	75	36.344	0.00	0.17
SS-098	03/08/89	0715	1872.7	16.20	84.40	26.30	0			
SS-099	03/08/89	0810	1872.7	16.20	84.40	26.30	0	36.009	0.01	0.09
SS-100	03/08/89	1132	1901.2	16.20	84.35	26.20	77	35.604	0.00	0.00

C-104 Surface Sample Summary Data

Station #	Date	Time	Log	Latitude	Longitude	Surf Temp (oC)	Bt #	Salinity (%o)
SS-101	03/08/89	1615	1926.0	16.05	85.20	26.00	0	35.630
SS-102	03/08/89	2100	1949.3	16.00	85.62	26.80	0	35.357
SS-103	03/09/89	0020	1970.0	16.10	85.37	26.10	0	35.003
SS-104	03/09/89	0620	2009.0	16.25	86.49	25.90	79	35.741
SS-105	03/09/89	0710	2015.0	16.27	86.56	25.00	0	
SS-106	03/10/89	0710	2016.3	16.25	86.53	26.00	0	
SS-107	03/13/89	1410	2032.5	16.40	86.04	27.70	80	36.070
SS-108	03/13/89	1624	2046.7	16.62	85.97	26.30	81	36.129
SS-109	03/13/89	2030	2071.2	17.02	85.83	25.80	82	36.326
SS-110	03/14/89	0110	2096.3	17.42	85.67	25.90	0	36.164
SS-111	03/14/89	0400	2115.4	17.77	85.52	25.90	84	36.153
SS-112	03/14/89	0641	2135.7	18.11	85.41	26.10	85	36.512
SS-113	03/14/89	0750	2145.5	18.35	85.70	26.10	0	
SS-114	03/14/89	0900	2155.9	18.42	85.65	26.00	86	36.361
SS-115	03/14/89	1454	2182.3	18.80	85.68	26.30	87	36.291
SS-116	03/14/89	1732	2201.8	19.13	85.56	26.30	88	36.256
SS-117	03/14/89	2010	2221.6	19.42	85.47	26.20	89	36.267
SS-118	03/14/89	2226	2241.0	19.82	85.30	26.20	90	36.268
SS-119	03/15/89	0310	2263.5	20.10	85.25	26.20	91	
SS-120	03/15/89	0650	2286.3	20.51	85.08	25.90	0	36.408
SS-121	03/15/89	0735	2290.0	20.60	85.29	26.00	0	
SS-122	03/15/89	0950	2304.6	20.71	85.20	26.00	93	36.301
SS-123	03/15/89	1301	2326.0	21.07	85.06	26.10	94	36.295
SS-124	03/15/89	1723	2346.1	21.43	85.13	26.08	95	36.290
SS-125	03/15/89	2050	2367.5	22.79	85.15	26.00	96	36.263
SS-126	03/15/89	2352	2387.6	22.02	85.21	26.00	97	36.274
SS-127	03/16/89	0423	2407.9	22.26	85.23	25.10	98	36.412
SS-128	03/16/89	0705	2415.6	22.28	85.18	25.80	0	
SS-129	03/16/89	1120	2427.1	22.43	85.17	26.00	99	36.327
SS-130	03/17/89	0308	2456.0	22.93	85.44	25.90	100	36.309
SS-131	03/17/89	0710	2475.3	23.25	85.42	25.30	0	
SS-132	03/17/89	0720	2476.1	23.30	85.33	25.60	101	36.293
SS-133	03/17/89	0950	2491.3	23.48	85.40	25.70	102	36.360
SS-134	03/17/89	1440	2513.0	23.64	85.10	26.00	0	36.321
SS-135	03/17/89	1800	2527.4	23.13	85.20	25.20	104	36.376
SS-136	03/18/89	0700	2569.1	23.52	84.26	25.80	0	
SS-137	03/18/89	0925	2580.9	23.50	84.01	25.70	106	36.368
SS-138	03/18/89	1247	2599.5	23.52	83.48	25.30	107	36.352
SS-139	03/18/89	1852	2619.4	23.59	82.75	25.90	108	36.325
SS-140	03/18/89	2140	2628.6	23.66	82.38	25.80	109	36.336
SS-141	03/18/89	2246	2635.3	23.83	82.32	25.75	0	36.336
SS-142	03/18/89	2326	2638.0	23.92	82.37	25.50	111	36.420
SS-143	03/19/89	0545	2658.1	23.66	82.60	25.70	112	36.369
SS-144	03/19/89	0700	2663.1	23.55	82.48	25.60	0	
SS-145	03/19/89	0740	2664.7	23.49	82.35	25.20	113	
SS-146	03/19/89	1000	2674.9	23.73	82.40	35.70	114	
SS-147	03/19/89	1150	2685.9	23.38	82.43	25.70	116	
SS-148	03/19/89	1255	2690.7	23.97	82.46	25.60	117	36.404
SS-149	03/19/89	1430	2697.4	23.34	82.40	25.60	118	36.354
SS-150	03/19/89	1645	2709.0	23.33	82.11	25.90	120	36.344
SS-151	03/19/89	2008	2728.0	23.03	82.13	25.10	122	

APPENDIX E

NEUSTON SUMMARY DATA
C-104
MIAMI-BAHAMAS-JAMAICA-ROATAN-MIAMI

Station #	Date	Time	Log	Latitude	Longitude	Zpl (ml/m2)	Sargassum (g/m2)
C-104-1-NA	02/10/89	1202	74.5	26.10	78.90	0.010	0.00
C-104-1-NB	02/10/89	1239	75.3	26.10	78.70	0.022	0.02
C-104-2-NA	02/11/89	0011	118.9	26.30	78.70	0.030	0.00
C-104-2-NB	02/11/89	0048	119.2	26.30	78.70	0.090	0.00
C-104-3-NA	02/12/89	0002	233.6	25.70	77.40	0.540	0.11
C-104-3-NB	02/12/89	0038	233.6	25.70	77.40	0.259	0.23
C-104-4-NA	02/12/89	1216	300.6	25.40	76.20	0.001	0.07
C-104-4-NB	02/12/89	1252	302.3	25.40	76.20	0.002	0.02
C-104-6-NA	02/15/89	0010	401.4	24.10	75.80	0.001	0.09
C-104-6-NB	02/15/89	0050	402.2	24.10	75.80	0.003	0.15
C-104-7-NA	02/20/89	0008	789.6	21.80	73.70	0.011	0.47
C-104-7-NB	02/20/89	0048	790.6	21.80	73.70	0.006	0.01
C-104-8-NA	02/20/89	0034	851.2	20.82	73.97	0.003	0.10
C-104-8-NB	02/20/89	0108	852.5	20.82	73.97	0.002	0.16
C-104-9-NA	02/21/89	1203	914.2	19.78	73.87	0.005	0.00
C-104-9-NB	02/21/89	1240	915.1	19.78	73.87	0.003	0.00
C-104-13-NA	02/22/89	1319	984.2	19.53	74.58	0.019	0.00
C-104-13-NB	02/22/89	1349	984.6	19.53	74.58	0.016	0.00
C-104-14-NA	02/26/89	2232	990.0	19.54	74.77	0.048	0.00
C-104-14-NB	02/26/89	2315	990.5	19.54	74.77	0.007	0.00
C-104-15-NA	02/26/89	0030	1152.0	18.30	76.50	0.004	0.06
C-104-15-NB	02/26/89	0057	1153.1	18.30	76.50	0.001	0.00
C-104-16-NA	02/27/89	1209	1205.6	18.25	75.25	0.004	0.00
C-104-16-NB	02/27/89	1245	1205.8	18.25	75.25	0.007	0.01
C-104-17-NA	02/28/89	0006	1255.9	18.22	76.00	0.011	0.00
C-104-18-NA	02/28/89	1203	1314.3	17.14	75.86	0.000	0.01
C-104-18-NB	02/28/89	1241	1315.9	17.14	75.86	0.003	0.00
C-104-19-NA	03/02/89	1202	1427.6	17.04	78.52	0.002	0.06
C-104-19-NB	03/02/89	1241	1429.4	17.04	78.52	0.004	0.01
C-104-29-NA	03/04/89	0117	1542.3	17.24	78.92	0.012	0.03
C-104-29-NB	03/04/89	0155	1543.5	17.24	78.92	0.014	0.01
C-104-32-NA	03/04/89	1222	1563.6	16.96	79.37	0.004	0.04
C-104-32-NB	03/04/89	1303	1565.0	16.96	79.37	0.007	0.00
C-104-33-NA	03/04/89	2324	1611.6	16.33	79.75	0.013	0.00
C-104-33-NB	03/05/89	0001	1612.8	16.33	79.75	0.011	0.00
C-104-36-NA	03/06/89	1210	1705.9	16.78	81.19	0.006	0.00
C-104-36-NB	03/06/89	1250	1707.5	16.78	81.19	0.005	0.03
C-104-37-NA	03/07/89	1215	1771.9	17.04	82.33	0.031	0.01
C-104-38-NA	03/14/89	1155	2178.2	18.80	85.68	0.001	0.09
C-104-38-NB	03/14/89	1231	2179.8	18.80	85.68	0.001	0.01
C-104-39-NA	03/15/89	0000	2252.2	20.05	85.25	0.015	0.01
C-104-40-NA	03/15/89	1223	2318.8	21.12	85.14	0.001	0.05
C-104-40-NB	03/15/89	1300	2320.4	21.12	85.14	0.001	0.05
C-104-41-NA	03/16/89	0055	2393.9	22.10	85.21	0.010	0.41
C-104-41-NB	03/16/89	0136	2395.2	22.10	85.21	0.034	1.02
C-104-42-NA	03/16/89	1214	2426.8	22.49	85.33	0.001	0.01
C-104-44-NA	03/17/89	0007	2445.3	22.37	85.49	0.002	0.04
C-104-44-NB	03/17/89	0043	2446.7	22.37	85.49	0.002	0.00
C-104-45-NA	03/17/89	1203	2503.7	23.70	85.26	0.002	0.01

NEUSTON SUMMARY DATA
C-104
MIAMI-BAHAMAS-JAMAICA-ROATAN-MIAMI

Station #	Date	Time	Log	Latitude	Longitude	Zpl (ml/m2)	Sargassum (g/m2)
C-104-45-NB	03/17/89	1240	2504.9	23.70	85.26	0.004	0.16
C-104-46-NA	03/19/89	0010	2640.7	23.95	85.88	0.061	0.02
C-104-46-NB	03/19/89	0051	2640.9	23.95	85.88	0.060	0.13

APPENDIX F

C-104 Hydrocast Summary Data

Station #	Date	Time	Log	Lat.	Long.	Bottle #	Z (m)	Tw (oC)	Sal (%o)	PO4 (ug/l)	Chla (ug/l)	dO2 (ug/l)
C-104-08	02/20/89	1715	848.6	20.9	73.9	1	961	6.90	35.114	1.36		4.44
C-104-08	02/20/89	1715	848.6	20.9	73.9	2	710	9.96	35.331	1.51		3.67
C-104-08	02/20/89	1715	848.6	20.9	73.9	3	631	11.59	35.535	1.43		3.86
C-104-08	02/20/89	1715	848.6	20.9	73.9	4	0	16.15	36.266	0.35		4.92
C-104-08	02/20/89	1715	848.6	20.9	73.9	5	411	17.85	36.507	0.13		4.74
C-104-08	02/20/89	1715	848.6	20.9	73.9	6	262	19.20	36.672	0.02		4.64
C-104-08	02/20/89	1715	848.6	20.9	73.9	7	112	19.98	36.729	0.00		4.94
C-104-08	02/20/89	1715	848.6	20.9	73.9	8	0	0.00	36.999	0.00		4.86
C-104-08	02/20/89	1715	848.6	20.9	73.9	9	125	24.38	36.852	0.02		5.25
C-104-08	02/20/89	1715	848.6	20.9	73.9	10	82	25.61	36.408	0.01		5.13
C-104-08	02/20/89	1715	848.6	20.9	73.9	11	0		36.373	0.00		4.94
C-104-08	02/20/89	1715	848.6	20.9	73.9	12	0		36.373	0.08		5.13
C-104-18	02/27/89	1630	1319.3	17.1	75.9	1	1200		36.318	0.96		0.00
C-104-18	02/27/89	1630	1319.3	17.1	75.9	2	950		36.586	0.41		3.06
C-104-18	02/27/89	1630	1319.3	17.1	75.9	3	850		36.654	0.40		3.21
C-104-18	02/27/89	1630	1319.3	17.1	75.9	4	650		36.781	0.39		3.20
C-104-18	02/27/89	1630	1319.3	17.1	75.9	5	500		36.987	0.10		2.64
C-104-18	02/27/89	1630	1319.3	17.1	75.9	6	350		36.837	2.31		3.09
C-104-18	02/27/89	1630	1319.3	17.1	75.9	7	300		36.166	2.77		3.08
C-104-18	02/27/89	1630	1319.3	17.1	75.9	8	225		36.492	2.73		3.23
C-104-18	02/27/89	1630	1319.3	17.1	75.9	9	175		36.315	0.11		3.72
C-104-18	02/27/89	1630	1319.3	17.1	75.9	10	125		0.000	0.61		3.29
C-104-18	02/27/89	1630	1319.3	17.1	75.9	11	100		36.324	10.00		4.28
C-104-18	02/27/89	1630	1319.3	17.1	75.9	12	75		36.063	8.30		2.80
C-104-19	03/01/89	0750	1340.7	16.8	77.2	1	160		36.565	0.01	0.11	
C-104-19	03/01/89	0750	1340.7	16.8	77.2	2	120		36.460	0.06	0.13	
C-104-19	03/01/89	0750	1340.7	16.8	77.2	3	110		36.300	0.05	0.18	
C-104-19	03/01/89	0750	1340.7	16.8	77.2	4	100		35.944	0.00	0.16	
C-104-19	03/01/89	0750	1340.7	16.8	77.2	5	75		34.916	0.03	0.16	
C-104-19	03/01/89	0750	1340.7	16.8	77.2	6	50		35.914	0.09	0.13	
C-104-20	03/01/89	1540	1368.8	17.2	77.2	1	160		35.882	0.75	0.09	
C-104-20	03/01/89	1540	1368.8	17.2	77.2	2	120		36.275	2.07	0.15	
C-104-20	03/01/89	1540	1368.8	17.2	77.2	3	110		36.246	1.46	0.08	
C-104-20	03/01/89	1540	1368.8	17.2	77.2	4	100		35.808	1.14	0.28	
C-104-20	03/01/89	1540	1368.8	17.2	77.2	5	75		35.845	0.00	0.18	
C-104-20	03/01/89	1540	1368.8	17.2	77.2	6	50		35.773	0.00	0.14	
C-104-20	03/01/89	1540	1368.8	17.2	77.2	0	0		0.000	0.00	0.10	
C-104-21	03/01/89	2103	1381.3	17.2	77.5	1	30		0.000	0.00	0.14	
C-104-21	03/01/89	2103	1381.3	17.2	77.5	2	20		35.891	0.00	0.09	
C-104-21	03/01/89	2103	1381.3	17.2	77.5	3	10		35.937	0.00	0.13	
C-104-21	03/01/89	2103	1381.3	17.2	77.5	0	0		35.823	0.00	0.00	
C-104-22	03/02/89	0150	1397.0	17.1	77.8	1	19		35.838	0.38	0.07	
C-104-22	03/02/89	0150	1397.0	17.1	77.8	2	13		35.806	0.23	0.02	
C-104-23	03/02/89	0910	1422.1	17.1	78.2	1	18		35.998	0.12	0.21	
C-104-23	03/02/89	0910	1422.1	17.1	78.2	2	9		35.998	0.17	0.13	
C-104-23	03/02/89	0910	1422.1	17.1	78.2	0	0		36.038	0.12	0.13	
C-104-25	03/02/89	2234	1457.1	17.5	78.7	1	20	25.87	36.005	0.15	0.09	
C-104-25	03/02/89	2234	1457.1	17.5	78.7	2	10	25.86	36.093	0.04	0.10	
C-104-25	03/02/89	2234	1457.1	17.5	78.7	0	0	0.00	36.173	0.06	0.11	
C-104-26	03/03/89	0215	1467.5	17.7	78.8	1	70	26.00	36.097	0.10	0.14	
C-104-26	03/03/89	0215	1467.5	17.7	78.8	2	43	26.02	36.002	0.17	0.19	

C-104 Hydrocast Summary Data

Station #	Date	Time	Log	Lat.	Long.	Bottle #	Z (m)	Tw (oC)	Sal (%o)	PO4 (ug/l)	Chla (ug/l)	dO2 (ug/l)
C-104-26	03/03/89	0215	1467.5	17.7	78.8	3	21	26.03	36.048	0.01	0.17	
C-104-26	03/03/89	0215	1467.5	17.7	78.8	4	10	0.00	0.000	0.04	0.16	
C-104-26	03/03/89	0215	1467.5	17.7	78.8	0	0	0.00	36.045	0.11	0.21	
C-104-28	03/03/89	1235	1495.3	17.5	79.1	1	100	26.09	36.063	0.00	0.43	
C-104-28	03/03/89	1235	1495.3	17.5	79.1	2	70	26.11	36.145	0.00	0.12	
C-104-28	03/03/89	1235	1495.3	17.5	79.1	3	50	26.10	36.130	0.03	0.23	
C-104-28	03/03/89	1235	1495.3	17.5	79.1	4	30	26.50	36.142	0.41	0.13	
C-104-28	03/03/89	1235	1495.3	17.5	79.1	5	10	26.18	36.195	0.09	0.13	
C-104-28	03/03/89	1235	1495.3	17.5	79.1	0	0	0.00	36.098	0.27	0.18	
C-104-29	03/03/89	0014	1540.0	17.3	78.9	1	20	25.97	36.961	0.13	0.17	
C-104-29	03/03/89	0014	1540.0	17.3	78.9	2	10	25.96	35.849	0.03	0.17	
C-104-29	03/03/89	0014	1540.0	17.3	78.9	0	0	0.00	36.107	0.38	0.18	
C-104-37	03/07/89	0735	1771.9	17.0	82.3	1	880	5.41	34.918	1.62		2.37
C-104-37	03/07/89	0735	1771.9	17.0	82.3	2	656	7.13	34.965	2.01		2.11
C-104-37	03/07/89	0735	1771.9	17.0	82.3	3	567	8.33	35.013	2.17		2.05
C-104-37	03/07/89	0735	1771.9	17.0	82.3	4	0			1.52		2.09
C-104-37	03/07/89	0735	1771.9	17.0	82.3	5	351	12.73	35.620	1.20		1.68
C-104-37	03/07/89	0735	1771.9	17.0	82.3	6	205	17.39	36.445	0.68		2.10
C-104-37	03/07/89	0735	1771.9	17.0	82.3	7	172	18.84	36.716	0.05		2.48
C-104-37	03/07/89	0735	1771.9	17.0	82.3	8	128	21.99	36.951	0.12		3.09
C-104-37	03/07/89	0735	1771.9	17.0	82.3	9	0	0.00	36.356			4.67
C-104-37	03/07/89	0735	1771.9	17.0	82.3	10	0	0.00	36.307		0.01	3.76
C-104-37	03/07/89	0735	1771.9	17.0	82.3	11	0	0.00	36.248		0.17	3.23
C-104-43	03/16/89	1652	2346.0	22.7	85.3	0	0	0.00	36.301			4.85
C-104-43	03/16/89	1652	2346.0	22.7	85.3	1	679	10.40	35.303			3.24
C-104-43	03/16/89	1652	2346.0	22.7	85.3	2	544	13.11	35.728			3.62
C-104-43	03/16/89	1652	2346.0	22.7	85.3	3	476	15.08	36.057			4.12
C-104-43	03/16/89	1652	2346.0	22.7	85.3	4	350	0.00	36.504			4.03
C-104-43	03/16/89	1652	2346.0	22.7	85.3	5	303	19.29	36.703			4.09
C-104-43	03/16/89	1652	2346.0	22.7	85.3	6	192	22.47	36.981			3.98
C-104-43	03/16/89	1652	2346.0	22.7	85.3	7	150	0.00	36.904			4.23
C-104-43	03/16/89	1652	2346.0	22.7	85.3	8	124	25.46	36.314			4.74
C-104-43	03/16/89	1652	2346.0	22.7	85.3	9	87	25.51	36.291			4.90
C-104-43	03/16/89	1652	2346.0	22.7	85.3	10	60	0.00	36.273			4.40

APPENDIX G

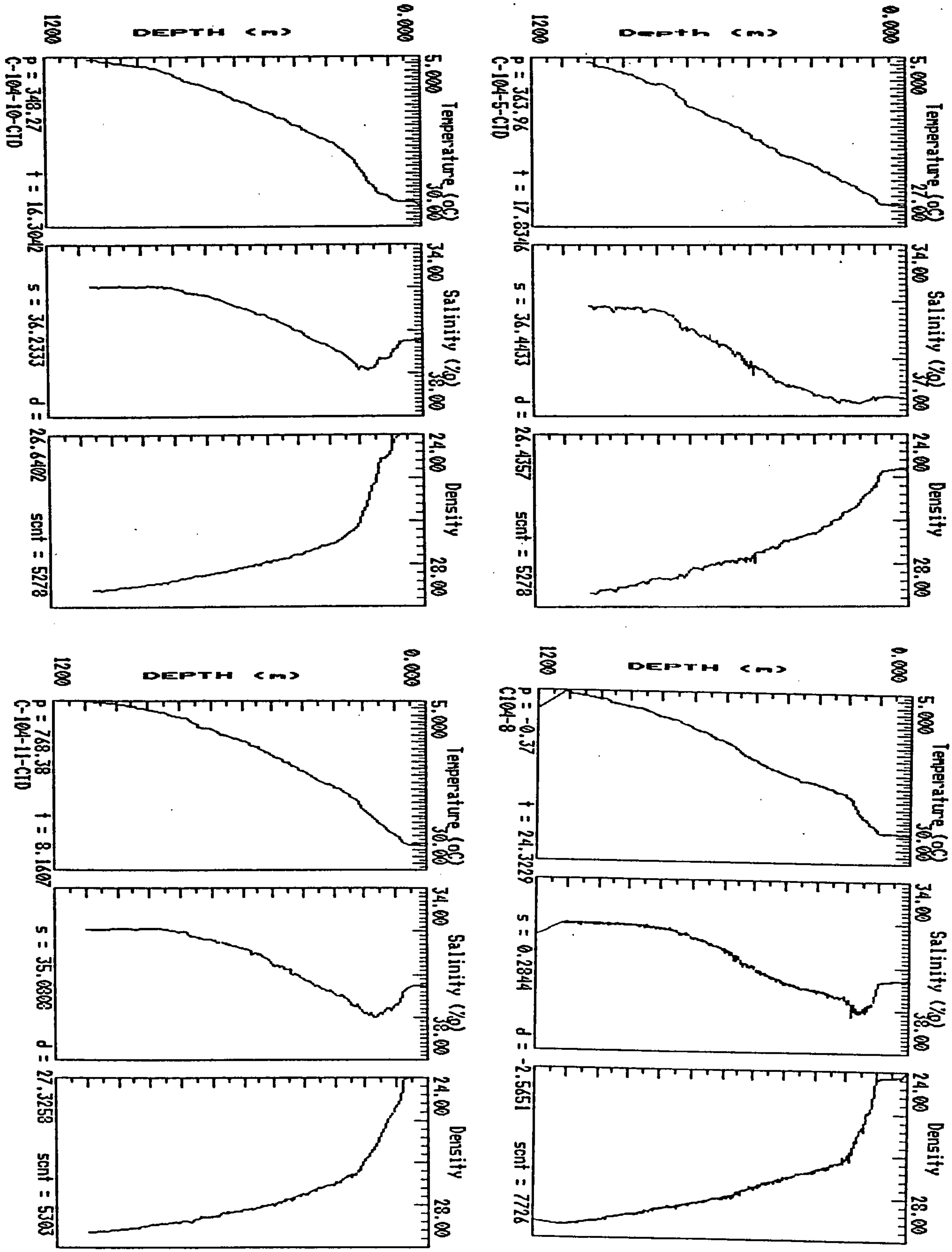
C-104 Shipek Grab Summary

Station #	Date	Time	Log	Lat	Long	Depth	General Locale	Qualitative Description
C-104-23-S	03/02/89	0945	1422.1	17.10	78.25	24	PEDRO BANK	CaCO3 SEDIMENT
C-104-24-Sa	03/02/89	1915	1443.4	17.40	78.61	30	PEDRO BANK	Med/Fine sand,Halimeda
C-104-24-Sb	03/02/89	1920	1443.4	17.40	78.61	30	PEDRO BANK	Nothing
C-104-25-S	03/02/89	2215	1457.1	17.50	78.69	35	PEDRO BANK	med grain sand
C-104-26-S	03/03/89	0123	1467.1	17.68	78.69	1120	PEDRO BANK	
C-104-27-Sa	03/03/89	0540	1476.6	17.74	78.78	950	PEDRO BANK	fine sand,pteropod sed
C-104-27-Sb	03/03/89	0540	1476.6	17.75	78.78	950	PEDRO BANK	fine sand,silt
C-104-28-Sa	03/03/89	1111	1395.3	17.52	78.98	703	PEDRO BANK	nothing
C-104-28-Sb	03/03/89	1131	1395.3	17.52	78.98	700	PEDRO BANK	nothing
C-104-28-Sc	03/03/89	1300	1395.3	17.52	78.98	835	PEDRO BANK	fine sediment
C-104-29-S	03/03/89	2352	1540.0	17.59	78.90	36	PEDRO BANK	coarse sand,forams,corl
C-104-30-Sa	03/04/89	0411	1544.8	17.19	79.03	430	PEDRO BANK	nothing
C-104-30-Sb	03/04/89	0430	1544.8	17.19	79.03	590	PEDRO BANK	very fine sediment
C-104-34-Sa	03/05/89	1020	1638.9	15.99	80.25	1020	ROSALIND BANK	nothing
C-104-34-Sb	03/05/89	1050	1638.9	15.98	80.25	1030	ROSALIND BANK	
C-104-34-Sc	03/05/89	1246	1642.2	15.99	80.25	1030	ROSALIND BANK	
C-104-34-Sd	03/05/89	1347	1642.2	17.99	80.25	940	ROSALIND BANK	
C-104-34-Se	03/05/89	1445	1643.5	15.99	80.25	750	ROSALIND BANK	
C-104-34-Sf	03/05/89	1535	1644.7	15.99	80.25	425	ROSALIND BANK	
C-104-34-Sg	03/05/89	1552	1644.7	15.99	80.25	270	ROSALIND BANK	
C-104-34-Sh	03/05/89	1610	1644.7	15.99	80.25	155	ROSALIND BANK	
C-104-34-Si	03/05/89	1622	1644.7	15.99	80.25	37	ROSALIND BANK	
C-104-34-Sj	03/05/89	1820	1644.7	16.19	80.40	33	ROSALIND BANK	
C-104-35-Sa	03/05/89	2234	1664.9	16.35	80.49	24	ROSALIND BANK	med sand,foram,halim,pt
C-104-35-Sb	03/06/89	0140	1680.1	16.55	80.65	32	ROSALIND BANK	
C-104-35-Sc	03/06/89	0455	1695.4	16.60	80.82	460	ROSALIND BANK	
C-104-35-Sc	03/06/89	0515	1695.4	16.60	80.82	470	ROSALIND BANK	

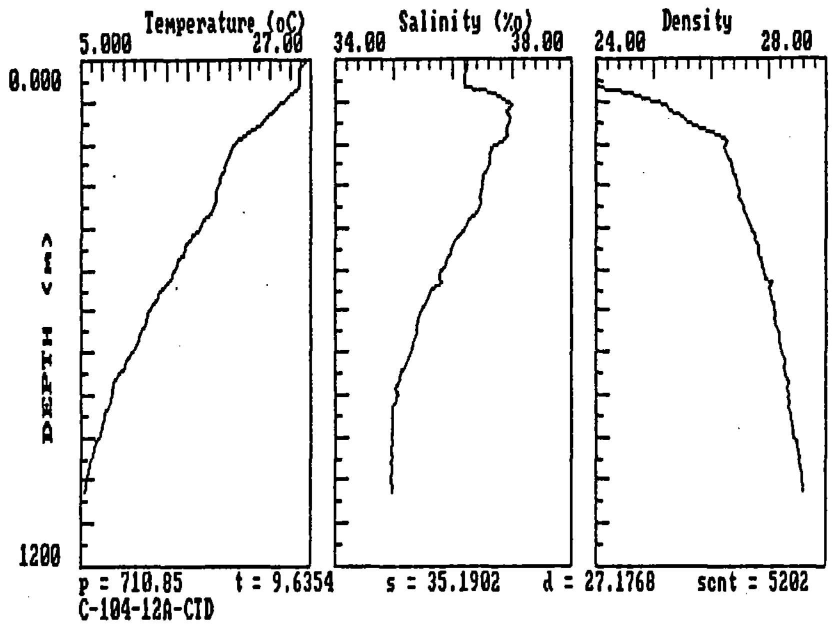
APPENDIX H

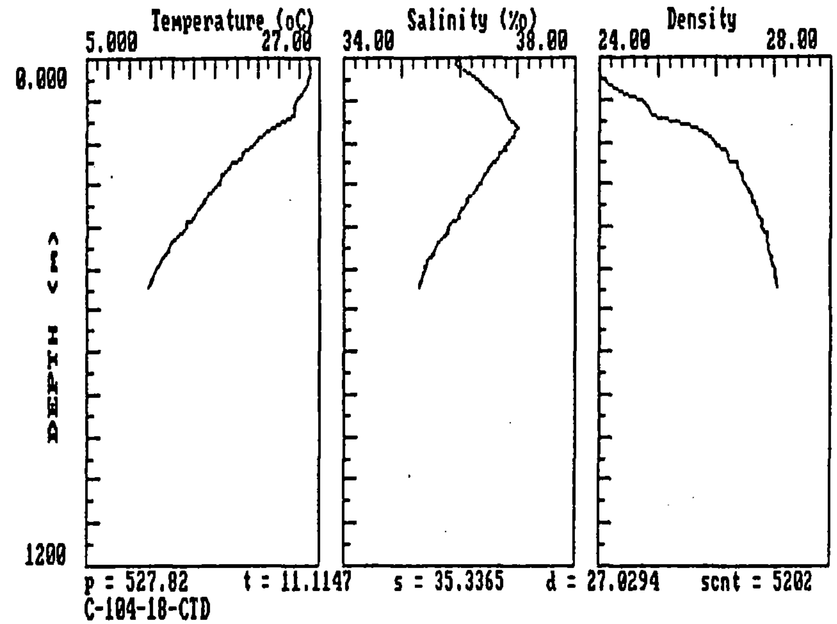
C-104 Meter Net Summary

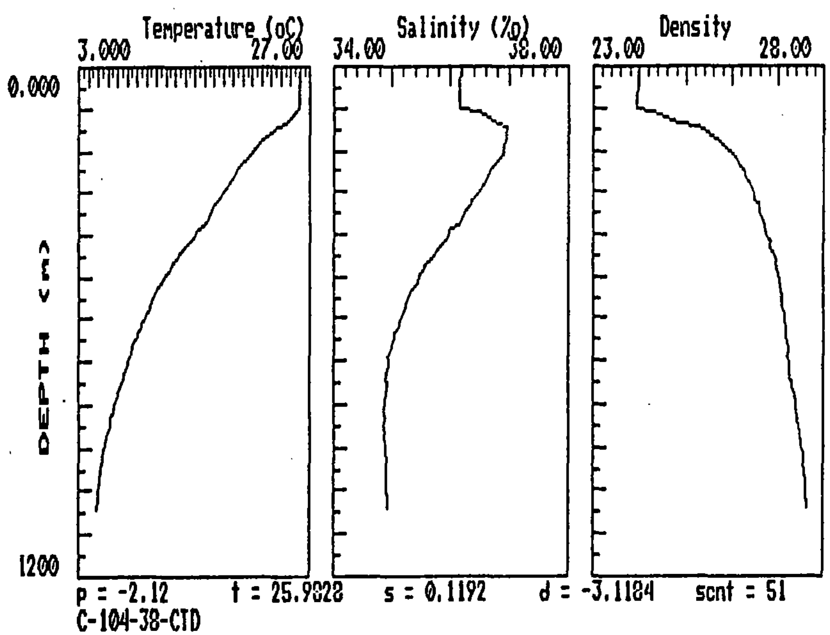
Station #	Date	Time	Log	Lat.	Long.	Tow Depth (m)	Zpl (ml/m3)
C-104-08-MN1	02/20/89	2250	849.6	20.92	73.88	400	0.009
C-104-08-MN2	02/20/89	2308	849.6	20.92	73.88	300	0.022
C-104-08-MN3	02/20/89	2316	849.6	20.92	73.88	200	0.031
C-104-14-MN1	02/22/89	2100	987.0	19.54	74.77	400	0.023
C-104-14-MN2	02/22/89	2112	987.0	19.54	74.77	300	0.024
C-104-14-MN3	02/22/89	2120	987.0	19.54	74.77	200	0.031
C-104-18-MN1	02/27/89	2350	1319.3	17.03	76.39	400	0.068
C-104-18-MN2	02/28/89	0014	1319.3	17.03	76.39	200	0.149
C-104-18-MN3	02/28/89	0027	1319.3	17.03	76.39	100	0.256
C-104-33-MN1	03/04/89	2128	1610.8	16.35	79.74	400	0.019
C-104-33-MN2	03/04/89	2138	1610.8	16.35	79.74	300	0.092
C-104-33-MN3	03/04/89	2148	1610.8	16.35	79.77	200	0.325

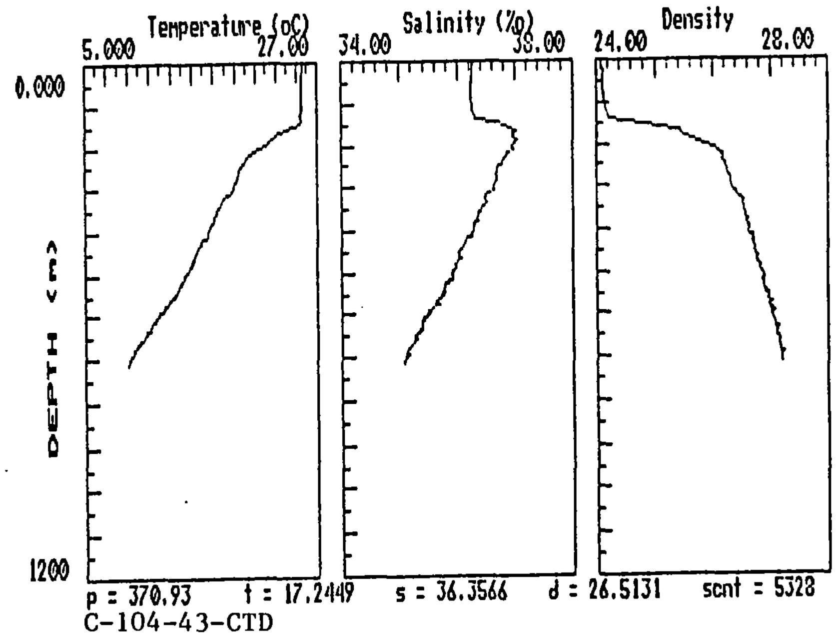


CTD Profiles of Temperature, Salinity and Density.


Temperature (oC)
5.000 27.00
Salinity (%o)
34.00 38.00
Density
24.00 28.00
0.000
DEPTH (m)
1200
p = 710.85 t = 9.6354 s = 35.1902 d = 27.1768 scnt = 5202
C-104-12A-CTD


Temperature (oC)
5.000 27.00
Salinity (%o)
34.00 38.00
Density
24.00 28.00
0.000
DEPTH (m)
1200
p = 527.82 t = 11.1147 s = 35.3365 d = 27.0294 scnt = 5202
C-104-18-CTD


Temperature (oC)
3.000 27.00
Salinity (%o)
34.00 38.00
Density
23.00 28.00
0.000
DEPTH (m)
1200
p = -2.12 t = 25.9828 s = 0.1192 d = -3.1184 scnt = 51
C-104-38-CTD


Temperature (oC)
5.000 27.00
Salinity (%o)
34.00 38.00
Density
24.00 28.00
0.000
DEPTH (m)
1200
p = 370.93 t = 17.2449 s = 36.3566 d = 26.5131 scnt = 5328
C-104-43-CTD

APPENDIX J

SUMMARY OF CORAL REEF INVESTIGATIONS

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Coral reefs are among the most productive, diverse, and interesting ecosystems. The first leg of the cruise track of C-104 included stops at Little San Salvador (LSS) and West Plana Cay (WPC), both in the Bahamas and both with varying degrees of coral reef development. Small and uninhabited, these islands are relatively unspoiled, although their proximity to other Bahamian islands and their position relative to prevailing winds hardly qualifies them as pristine. In fact, human influences are common, from an old conch fishing village to plastic and tar debris on the beaches.

The objectives of this investigation were the following: 1) conduct an initial survey of the physical organization of these reefs; 2) survey the reef flora and fauna; and 3) look for evidence of two recent reef perturbations, the Diadema die-off and coral bleaching. A bonus was provided by the opportunity to examine the large central lagoon at Little San Salvador.

The most structured survey was conducted on the northwestern shore of LSS on 13-14 FEB 1989. Using snorkeling gear, a transect line was run from the shore to the outer edge of the "inner" reef (the "outer" reef is further offshore and too deep for snorkeling). Thirty meters long, the transect line was repetitively advanced across the reef. The reef is on the windward side of the island, and the previous days had been marked by high winds. Consequently, the wave action was very intense, making snorkeling exceedingly difficult, and the use of transects all but impossible. Nevertheless, one complete transect was completed. The other investigation sites (West Bay - LSS, Lagoon - LSS, West Side - WPC, East Side - WPC) were examined in a less-structured manner.

All of the reefs examined were in water 0-9 m deep and were characterized by a series of isolated and interconnected coral heads, rising close (a meter or less) to the surface and separated by varying expanses of sand on the bottom. The sand was composed of fine carbonate sediments and was typically barren. The exception was the East Side of WPC; turtle (Thalassia) and manatee (Cymodocea) grasses were abundant, along with various calcareous algae (e.g., Rhipocephalus and Udotea) and benthic invertebrates (e.g., Strombus). In fact, the bottom community was reminiscent of a lagoon and may be the result of a "barrier reef" further offshore that cuts down much of the wave action.

The percentage of live "structural invertebrates" (e.g., hard and soft corals, sponges) was low at all reef sites; a typical coral head was composed of the underlying dead coral, covered by a sediment/algal mat a few cm deep, with occasional outcrops of scleractinians and gorgonians. Coral heads in less turbulent water (e.g., West Bay - LSS) tended to have better stands of live coral. Sponges in general were uncommon at all reef sites.

The assemblage of fishes found at each site was typical of other reefs in the western (sub-) tropical Atlantic. Labrids, scarids, and pomacentrids were dominant, while several other families (mostly perciforms) were represented in smaller numbers. More data and analysis is needed before significant comparisons can be made between these various study sites, as well as between inshore reef environments (of which the study sites are all examples) and offshore reefs (i.e., depths greater than 10 m and/or closer to the drop-off).

The long-spined urchin (Diadema antillarum) was absent from all reefs except for a small (ca. 50x30 m) coral head in West Bay - LSS. No conclusions regarding the Diadema die-off can be made without baseline data for comparison. Virtually no evidence of coral bleaching was observed, but little effort was directed towards that question.

The lagoon community was of particular interest. Although only the western end was examined, certain patterns became evident. There appear to be three zones into which the lagoon inhabitants are partitioned: 1) inner lagoon, 2) lagoon perimeter, and 3) mangrove areas. The inner lagoon is essentially any part of the lagoon starting 4-5 m from shore. This region is dominated by turtle grass (Thalassia) and calcareous algae (especially Rhipocephalus and Penicillus), but various invertebrates are also common (e.g., Condylactis anemones). However, the virtual absence of fishes is striking.

The lagoon perimeter is quite different. Defined as a band about 4-5 m wide and extending from shore, the ichthyofauna dramatically increases in this zone. The increase in fish diversity and biomass can probably be attributed to the increase in vertical relief along the lagoon perimeter. Rugged limestone rock along the shore and a moderate increase in coral formations are the source of this geometrical complexity. Another observation in the perimeter zone is the large number of juvenile fishes, including carangids and serranids. This supports the view that the lagoon functions as a nursery area for fishes that will eventually live on deeper reefs.

The mangrove area was the least examined, due to high turbidity created by other investigators. However, schools of "bait" fishes were observed (including the dwarf herring, Jenkinsia lamprotaenia), as well as larger fishes such as the bluestriped grunt (Haemulon sciurus).

As with other studies of this nature, few serious characterizations of the reef and lagoon environments can be made without repetitive observations over long periods of time using more quantitative and systematic techniques. However, the above-described work does have its value in at least two ways: 1) By conducting field research, logistical limitations and modifications are quickly learned. These lessons are useful in subsequent field seasons. 2) A certain body of information and data was collected that could be utilized as a type of "baseline" condition against which future studies could be compared. In time, the complex ecological interrelationships on coral reefs will become further elucidated.